Initials_____ Date_____

SOLID WASTE PROGRAM ROUTE SLIP

☐ **NEW APPLICATION** — **Initial / Date**

Jim W. _____
Jon D. _____
Proof _____
Cathy _____
Roger _____

☐ **NEW LICENSE** — **Initial / Date**

Jim W. _____
Jon D. _____
Proof _____
Carol _____
Cathy _____
Roger _____

☐ **HEALTH OFFICER CARD** — **Initial / Date**

Jim W. _____
Carol _____
Cathy _____
_____ _____

☐ **INSPECTIONS** — **Initial / Date**

Pat C. _____
Jon D. _____
Proof _____
Carol _____
Roger _____

☐ **INTERIM CLOSURES** — **Initial / Date**

Jim W. _____
Jon D. _____
Proof _____
Carol _____
Cathy _____
Roger _____

☐ **CLOSURES** — **Initial / Date**

Jim W. _____
Jon D. _____
Proof _____
Carol _____
Cathy _____
Roger _____

☐ **CHANGE IN LICENSE FOR FEE STATUS** — **Initial / Date**

Jim W. _____
Jon D. _____
Proof _____
Cathy _____
Roger _____

☐ **COMPLAINTS** — **Initial / Date**

Pat C. _____
Jon D. _____
Proof _____
Roger _____
Carol (filing & DBase) _____

☐ **GENERAL CORRESPONDENCE** — **Initial / Date**

G.W FPC 8/31/95
~~Pat C./Jim W.~~ PJ 9/1 Comments "Memo to File"
JD 8/31/95
Jon D. _____
Proof _____
Roger _____

☐ **MISCELLANEOUS** — **Initial / Date**

_____ _____
_____ _____
_____ _____
_____ _____

DEPARTMENT OF
ENVIRONMENTAL QUALITY

Waste Management Division
Solid Waste Program
406/444-1430

FAX # (406) 444-1499

STATE OF MONTANA

OFFICE LOCATION: 2209 PHOENIX AVE. HELENA, MONTANA

MAILING ADDRESS: PO BOX 200901 HELENA, MT 59620-0901

September 1, 1995

Jim Johnson
Director of Public Works
Butte-Silver Bow County
155 West Granite
Butte, MT 59701

Dear Jimmy:

The Department cannot approve changing the downgradient monitoring to include only wells MW-A1 and MW-A5 as Pioneer has requested on your behalf. This monitoring array would not meet the requirements of ARM 16.14.704(2), which governs the placement of downgradient monitor wells. This rule states:

> Downgradient groundwater quality monitoring wells **must be capable of detecting a migration of hazardous constituents from active and closed waste disposal areas.** The number and location of downgradient monitoring wells must be approved in writing by the department. At least two downgradient monitoring wells are required, although the department may require more.
>
> (a) The downgradient monitoring system must be installed at the relevant point of compliance specified by the department **that ensures detection of ground water contamination in the uppermost aquifer.** When physical obstacles preclude installation of ground water monitoring wells at the relevant point of compliance at existing units, the down-gradient monitoring system may be installed at the closest practicable distance hydraulically down-gradient from the relevant point of compliance specified by the department. (Emphasis added.)

In addition, ARM 16.14.708(1)(f), in the Definition of Extent of Contamination rule states:

> The relevant point of compliance (POC) to determine if an enforcement standard or preventive action limit has been attained or exceeded is specified as no more than 150 meters beyond the waste management unit boundary and must be located **on land owned by the owner of the disposal unit.**
> (i) The downgradient monitoring system must be installed at the POC specified by the department **that ensures detection of ground water contamination in the uppermost aquifer.** (Emphasis added.)

There is apparently a plume of contamination emanating from the landfill in the vicinity of MW-A2 and MW-A3. Well MW-5 demonstrates one place where the plume is not. According to the requirements of ARM 16.14.708(4)(a)(i), ("Must characterize the nature and extent of the release by installing additional monitoring wells as necessary;"), the extent of this plume must be delineated so that the appropriate corrective measure(s) can be selected. A plan for these studies should already have presented to the Department, as required by my June 19, 1995 letter.

Characterization may be done by a variety of methods, including, but not limited to, the installation of temporary or permanent ground water monitoring wells. Geophysical studies are also sometimes helpful. We anticipate that wells placed through the Clark Tailings, on a line parallel to the former solid waste cell boundary, will both provide information on the actual direction of ground water flow and a better delineation of the plume. (See attached map.) Please present a plan to the Department for approval.

Once the plume is delineated, then the appropriate POC can be selected. It is the intention of the Program to select a point that will allow corrective measures to be effective while minimizing the impact of the leakage from the landfill to the waters of the State. Monitor wells placed at a distance of not more than 450 feet from the waste management unit boundary could possibly be considered for inclusion in an assessment monitoring array.

Please remember that the corrective measures sampling program required by ARM 16.14.708(8)(a)(i) may have different wells, sampling frequencies, and constituents from the detection or assessment monitoring programs.

Once a better idea of the extent of contamination is known, then the appropriate subset of wells can be selected for each program. It may well be that some wells are sampled initially and then not again for several intervals when they are once again needed to provide information on the effectiveness of the corrective measure(s).

During our July 12, 1995, meeting, the question was posed that if the POC was moved to the maximum extent allowed into the Clark Tailings, and all wells were "clean", would this stop the Assessment of Corrective Measures (ACM) process? The answer to this question is "no". The detection of a release of contaminants, at the current POC, has opened Pandora's Box. The ACM process has been started and should have been completed by now. I can find no provision in the rules to stop the process.

The selection of remedy may be greatly affected by the definition of extent of contamination studies. The Department could consider altering the monitoring well system, however changes to the system must meet the basic detection and environmental protection requirements. The delineation studies must be thorough enough to provide the Department with a sound basis to make the determination that altering the monitoring array will meet these requirements. If the plume delineation studies show that the ground water protection standard is achieved at an extended POC, then the remedy for the contamination may consist of the completion of the final cover.

Remedies are considered complete according to the requirements of ARM 16.14.708(8)(e). First, this means achieving the GWPS for all points within the plume beyond the monitoring system, (proof of the off-site clean up). Second, there must be no GWPS exceedances at any POC well for three years, (proof of removal of continuous sources of contamination).

In addition to the detection requirements, the POC must be on property owned by Butte-Silver Bow. We have not yet received notification that BSB owns the Clark Tailings. Please supply the Department with the necessary documentation as soon as the transfer takes place.

The construction season is slipping away rapidly. The Department expects a reply to this, and the June 19, 1995 letter, no later than September 15, 1995.

If you have any questions, please feel free to contact me.

Sincerely,

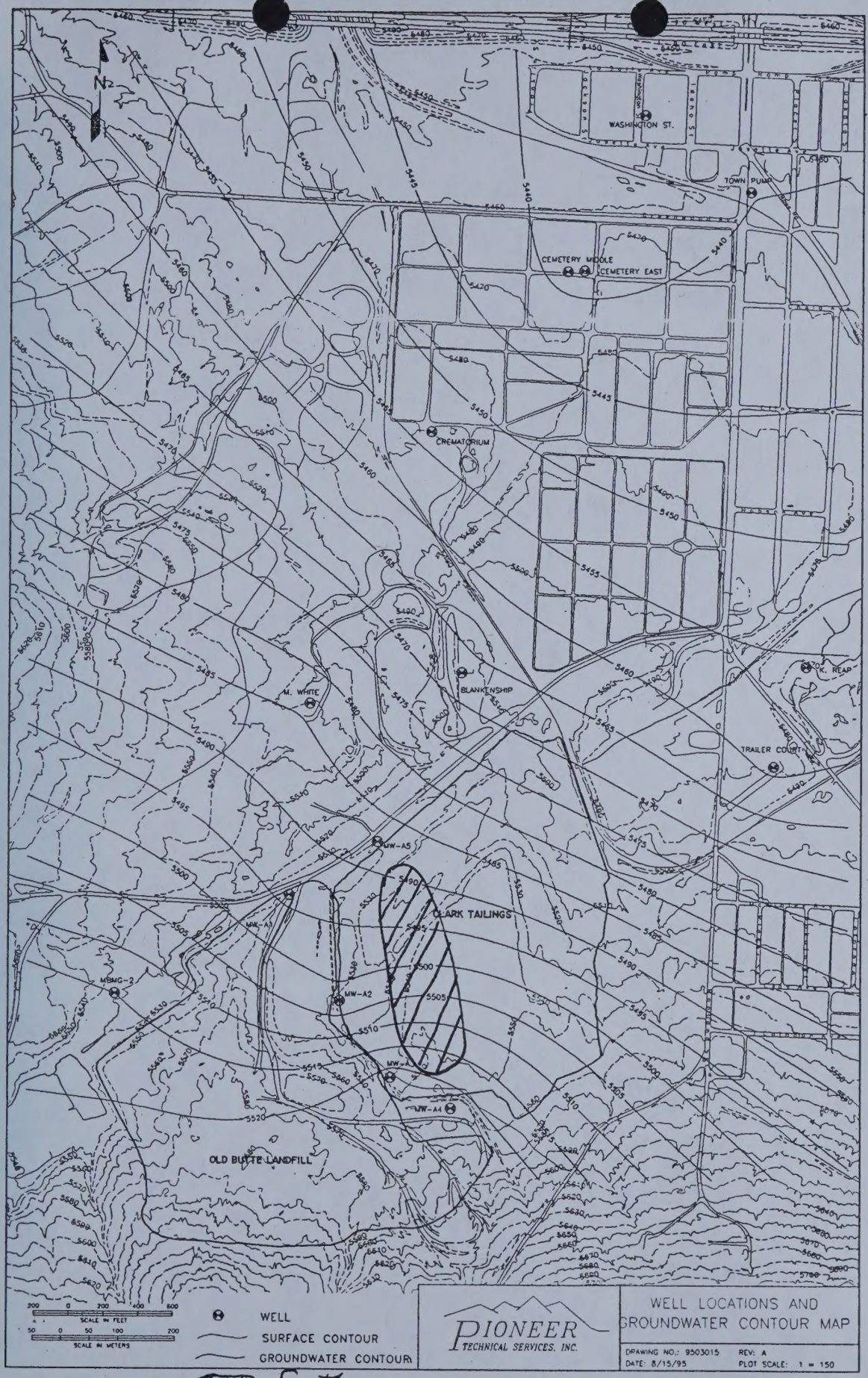
Pat Crowley

F. Patrick Crowley
Solid Waste Regulatory Lead

Enclosure, map.

cc: Pioneer Technical Services, P.O. Box 3445, Butte, MT 59702
Sara Weinstock, EPA
James Scott, ERD

File:Old Butte Landfill\ground water
Path:F:\USR\cb5403\wp\landfill\closure\butte\poc.901



Further investigation needed.

DEPARTMENT OF
ENVIRONMENTAL QUALITY

STATE OF MONTANA

FAX # (406) 444-1499

OFFICE LOCATION: 2209 PHOENIX AVE. HELENA, MONTANA

MAILING ADDRESS: PO BOX 200901 HELENA, MT 59620-0901

Waste Management Division
Solid Waste Program
(406) 444-1430

MEMORANDUM

TO: the Solid Waste Program - old Butte Silver Bow Landfill file
Ground Water

FROM: Pat Potts

DATE: 9/1/95

SUBJECT: Comments on Pat Crowley's August 31, 1995 letter to Jim Johnson concerning the old Butte-Silver Bow Class II Landfill (inactive) - License No. 20

I was asked to review this letter as part of the routing process. I have read the letter and find the general tone to be condescending and rude. The first two pages are a nightmare of regulatory mumbo-jumbo.

The issue here, as I briefly understand it, since Pat took on the responsibilities of ground water regulatory oversight and I am not intimately familiar with the current data, is that Butte-Silver Bow would like to extend the original RPOC that was at the waste management unit boundary (WMUB) by acquiring more property in the area of the Clark tailings to the east. To date, the Department has already set a president that through acquisition of additional property, the RPOC can be extended to the maximum 150 meters allowable beyond the WMUB. That is, if there are no immediate receptors in the area, and there is no threat to human health and the environment. The old Sidney landfill is one such case however, it is remotely located. Polson may or may not be a case; have they ever decided what they wanted to do? The City of Helena monitors at the extended 150 meter RPOC on the north side (downgradient). Flathead County may ask for the same extension of the RPOC based on additional current property acquisition.

Each facility is hydrogeologic and contaminant oriented site-specific. In the case of old Butte-Silver Bow Landfill, constituent concentrations are not of a high enough level to suggest a cost-effective pump and treat at either the WMUB or the

extended RPOC. The constituents of higher concentration levels appear to consist of the lighter phase VOCs (i.e., more closely associated with landfill gases (dichlorobenzene, dichloropropane, vinyl chloride), with levels of the heavier chlorinated solvents such as, tetrachloroethene and trichloroethene being detected at or below the MCL.

My first suggestion is to review where the screen is set in the wells with VOCs. If there is a portion of the screen above the water table, landfill gases may be directly condensing in the well-bore. New wells should be drilled and screened below the water table, if this is the case. However, the old wells should be temporarily retained for sample comparisons.

If, in fact, landfill gases have already been detected at this site, this information should be considered as well. What this all comes down to is:

> The ground water has been impacted with VOCs. It looks like a landfill gas problem. Gas extraction, which may be required anyway, should indirectly solve the immediate Corrective Measures need along with adequate cap, vegetative cover, and drainage.
>
> If they want 150 meters of impact zone in the ground water, the Department should give it to them, but the extended RPOC must be monitored along with the WMUB wells to better determine the rate of contaminant migration in the ground water. The WMUB wells could be termed observation wells and used to better understand the nature of the plume(s). I think Pioneer estimates ground water velocity ranges from 1 to 300 ft/da. This is to large a range to be acceptable however, from these figures it appears clear that the landfill plume(s) could very rapidly occupy the additional 150 meters if no remdial (passive or active) measures are promptly put into place. The Department may have to live with this, but gas regulatory measures may help to alleviate some of the ground water problems, along with cap, vegetation, and drainage.

In my opinion this letter will only make them angry. May be an approach along the above technical aspects could be considered.

LANDFILL ROU[redacted]LIP

☐ **NEW APPLICATION** — Initial / Date
- Jim W. _____
- Jon D. _____
- Michelle (proof) _____
- Cathy _____
- Roger _____

☐ **NEW LICENSE** — Initial / Date
- Jim W. _____
- Jon D. _____
- Michelle (proof) _____
- Carol _____
- Cathy _____
- Roger _____

☐ **HEALTH OFFICER CARD** — Initial / Date
- Jim W. _____
- Carol _____
- Cathy _____
- Michelle _____

☐ **INSPECTIONS** — Initial / Date
- Pat C. _____
- Jon D. _____
- Michelle (proof) _____
- Carol _____
- Roger _____

☐ **INTERIM CLOSURES** — Initial / Date
- Jim W. _____
- Jon D. _____
- Michelle (proof) _____
- Carol _____
- Cathy _____
- Roger _____

☐ **CLOSURES** — Initial / Date
- Jim W. _____
- Jon D. _____
- Michelle (proof) _____
- Carol _____
- Cathy _____
- Roger _____

☐ **CHANGE IN LICENSE FOR FEE STATUS** — Initial / Date
- Jim W. _____
- Jon D. _____
- Michelle (proof) _____
- Cathy _____
- Roger _____

☐ **COMPLAINTS** — Initial / Date
- Pat C. _____
- Jon D. _____
- Michelle (proof) _____
- Roger _____
- Carol (filing & DBase) _____

☐ **GENERAL CORRESPONDENCE** — Initial / Date
- Pat C./Jim W. _____
- Jon D. _____
- Michelle (proof) _____
- Roger _____

☑ ~~MISCELLANEOUS~~ GW — Initial / Date
- Proof — JW 6-19
- Pat C. — ~~PC~~ 6-19
- Jon D — JD 6-19
- Roger T — RT

Sw/silvNbut.wls

DEPARTMENT OF
HEALTH AND ENVIRONMENTAL SCIENCES
Waste Management Division
Solid Waste Program
406/444-1430
FAX # (406) 444-1902
STATE OF MONTANA
OFFICE LOCATION: 2209 PHOENIX AVE. HELENA, MONTANA
MAILING ADDRESS: PO BOX 200901 HELENA, MT 59620-0901

June 20, 1995

Gary Keeler
Department of Public Works
Butte-Silver Bow Courthouse
Butte, Montana 59701

RE: **BUTTE-SILVER BOW CLASS II LANDFILL, SILVER BOW COUNTY - LICENSE NO. 20**
APPROVED TERMINATION OF MONTHLY GROUND WATER LEVEL MEASUREMENTS

Dear Mr. Keeler:

In response to Mr. Mike Fitzgerald's letter requesting a reduction in monthly ground water level measurements at the Butte-Silver Bow Class II Landfill, ARM 16.14.706(4)(a) requires only one year of monthly ground water level measurements to be reported on the ground water monitoring wells. Butte-Silver Bow has accomplished this requirement, and now will only need to measure water levels on the monitoring wells prior to conducting the semi-annual sampling events. We encourage the City-County to measure water levels in all of the monitoring wells during each sampling event whether or not they are part of the required sampling network. This information is helpful in being able to more accurately determine the direction of ground water flow for each sampling event, as required according to ARM 16.14.706(4)(a).

The Department would like to commend Butte-Silver Bow for their diligence in acquiring this data and for the clear, concise graphic display of this information included with Mr. Fitzgerald's letter. It is quite clear that there have been no seasonal fluctuations in the ground water levels in these monitoring wells for over a year.

As we discussed over the telephone on June 19, 1995, according to ARM 16.14 705(5)(b), it is important to submit to the Department

qualifications of any new employees or subcontractors that may be working with the ground water monitoring wells in the future.

Sincerely,

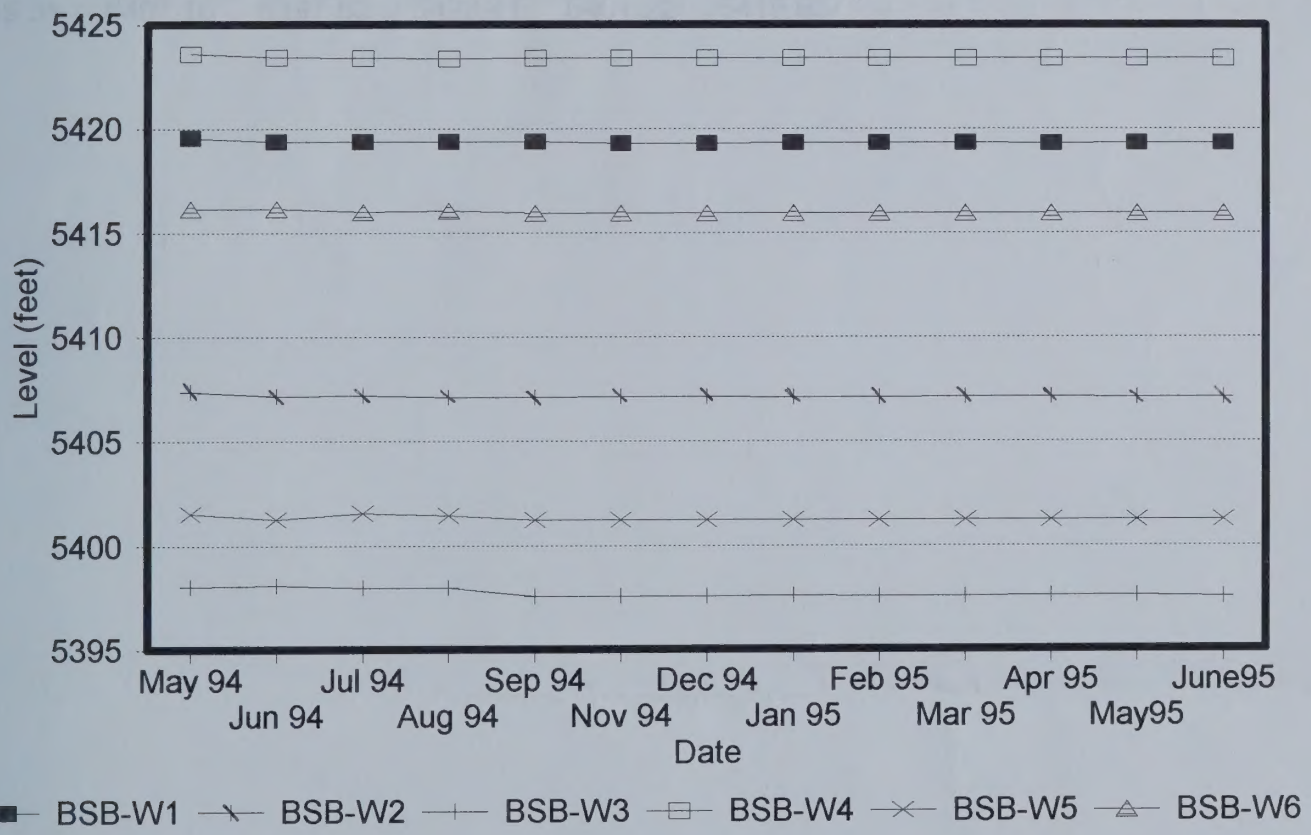
Pat Potts
Environmental Specialist

cc: Dan Powers R.S., Butte-Silver Bow County Sanitarians, 25 West Front Street, Butte, MT 59701

path: sw\silvnbut.wls
file: Silver Bow Co./new Butte-Silver Bow Class II/grd wtr (corr)

Butte-Silver Bow Municipal Landfill

Ground Water Levels



Ground Water Elevation (feet)

W1	W2	W3	W4	W5	W6
5419.54	5407.40	5398.05	5423.58	5401.52	5416.16
5419.39	5407.18	5398.09	5423.45	5401.28	5416.17
5419.38	5407.20	5397.98	5423.41	5401.56	5416.02
5419.36	5407.10	5397.98	5423.37	5401.44	5416.07
5419.37	5407.12	5397.55	5423.39	5401.21	5415.96
5419.30	5407.12	5397.55	5423.40	5401.23	5415.97
5419.29	5407.13	5397.55	5423.40	5401.22	5415.96
5419.31	5407.12	5397.59	5423.39	5401.24	5415.94
5419.31	5407.12	5397.55	5423.39	5401.24	5415.96
5419.32	5407.14	5397.56	5423.40	5401.23	5415.96
5419.30	5407.13	5397.57	5423.39	5401.23	5415.97
5419.31	5407.10	5397.57	5423.40	5401.23	5415.96
5419.31	5407.10	5397.53	5423.41	5401.22	5415.95

CLOSED
BUTTE-SILVER BOW LANDFILL
LICENSE NUMBER 20

PIONEER TECHNICAL SERVICES

VERIFICATION GROUNDWATER SAMPLING,
DECEMBER 1995

JANUARY 1996

IS LOCATED IN THE GROUNDWATER
MONITORING REPORTS ARCHIVE,
BOX NUMBER 7

RECEIVED 1/12/1996

CLOSED
BUTTE-SILVER BOW LANDFILL
LICENSE NUMBER 20

PIONEER TECHNICAL SERVICES

INORGANIC GROUNDWATER SAMPLING,
NOVEMBER 1995

DECEMBER 1995

IS LOCATED IN THE GROUNDWATER
MONITORING REPORTS ARCHIVE,
BOX NUMBER 7

RECEIVED 12/5/1995

CLOSED
BUTTE-SILVER BOW LANDFILL
LICENSE NUMBER 20

PIONEER TECHNICAL SERVICES

GROUNDWATER SAMPLING, AUGUST 1995

OCTOBER 1995

IS LOCATED IN THE GROUNDWATER MONITORING REPORTS ARCHIVE, BOX NUMBER 7

RECEIVED 10/17/1995

Silver Bow
Old L.F.
& Water.

PIONEER
TECHNICAL SERVICES, INC.
P.O. BOX 3445, BUTTE, MONTANA 59702 PHONE (406) 782-5177 FAX (406) 782-5866

RECEIVED
SEP 18 1995
Montana Department of
Environmental Quality
Waste Management Division

September 15, 1995

F. Patrick Crowley
Solid Waste Regulatory Lead
MDEQ/Waste Management Division, Solid Waste Program
P.O. Box 200901
Helena, Montana 59620-0901

RE: RESPONSE TO SEPTEMBER 1, 1995 LETTER FROM F. PATRICK CROWLEY TO JIM JOHNSTON

Dear Pat:

As we stated in our August 15, 1995, letter, we feel that the Relevant Point of Compliance (RPOC) for the old Silver Bow County Landfill would be best defined by the line between wells MW-A1 and MW-A5. Our letter contained our reasoning for this position; our letter also contained information showing that the RPOC we proposed satisfied the requirements of ARM 16.14.506(11). For these same reasons, we believe that the wells satisfy the requirements of ARM 16.14.704(2), which you reference in your letter.

As you stated in your letter, there appears to be a plume emanating from the vicinity of wells MW-A2 and MW-A3. Based on the groundwater flow direction at the site, we believe that well MW-A5 would detect this plume if it were migrating "off-site" (past the proposed RPOC). Based on this, we feel that we have adequately defined the extent of the contamination (it is not migrating past the proposed RPOC). The Department apparently does not agree with this and has asked us to provide a plan for further investigation to define the extent of the plume. Specifically, you have asked us to investigate the area east of the Clark Tailings/Landfill boundary. In accordance with your letter, we proposed to place one additional well (MW-A6) in this area, as shown on the attached figure. This new well would be no more than 150 meters from the landfill boundary, satisfying the requirements referenced in your letter. We feel that by adding this well, along with the recently installed well MW-A5, we will adequately define the extent of the contaminant plume. These investigative actions constitute our plan for delineating the extent of the plume, as required by your June 19, 1995, letter and re-stated in your September 1, 1995, letter. (A plan for filling other data gaps identified in the "Draft Corrective Measures Assessment" is discussed below.) It is our position that, with the installation of the new well (MW-A6), the extent of the plume will have been adequately delineated and no additional monitoring wells will be necessary.

100% post-consumer paper & 100% vegetable based inks

We propose that the RPOC be established by wells MW-A1, MW-A5, and MW-A6 (when it is installed). As you refer to in your letter, wells MW-A5 and MW-A6 are not on property owned by Butte-Silver Bow County at the time of this writing. I can assure you that BSB is in the process of acquiring this property, as we have discussed previously. Negotiations with Inland Properties, Inc., and ARCO have been more time consuming than we had anticipated. However, the agreement is very close to being finalized, with only some deed restriction clauses to be worked out. As soon as this agreement has been reached, we will forward you proper notification that BSB owns the property in question.

Once the new well is installed, we plan to sample the well for Table 1 constituents, which includes the metals and volatile organic compounds identified as constituents of concern (CoC) at the site. If the Department agrees to move the RPOC to the location we have proposed, wells MW-A1, MW-A5, and MW-A6 would be monitored as required in ARM 16.14.708(1). Wells MW-A2, MW-A3, and MW-A4 would be retained for the time being for possible use during this assessment of corrective measures process. Ultimately, BSB would abandon wells MW-A2, MW-A3, and MW-A4. The remaining wells would be used for assessment monitoring and post-closure detection monitoring (once the assessment of corrective measures process is complete). Our proposed sampling plan will be detailed in our plan to fill the data gaps identified in the Draft CMA report (discussed below).

You have asked us to respond to your June 19, 1995, letter regarding the "Draft Corrective Measures Assessment." Your comments (paraphrased) and our response, and/or actions we have taken, are summarized below.

LANDFILL CLOSURE (Section 4.1)

Comment: Will the proposed design meet regulatory requirements?

Regulatory standards require that the landfill cap meet permeability, erosion potential, and revegetation standards. As discussed in the Draft CMA, the portion of the landfill required to meet these standards (that which received waste after October 9, 1991) will be capped with local sandy, silty clays which meet the permeability requirements. Topsoil will be imported, amended with organic matter and/or fertilizer as necessary, and revegetated.

This topsoil layer must protect the infiltration layer from frost effects and rooting damage. In Butte, frost depths exceed three feet; we do not have enough material available to provide a cover thick enough to prevent frost penetration into the infiltration layer. Therefore, we have chosen a material for the infiltration layer that meets the permeability specification yet contains a high fraction of silts and sands; therefore, this material is not susceptible to frost damage to the extent that pure clays are. Therefore, it is our opinion that frost damage will not be significant. Rooting damage will not be detrimental, either. Compacted layers of fine materials, such as the material we are using for the infiltration layer, will restrict root growth (Wiersum, L.K., "The Relationship of the Size and Structural Rigidity of Pores to Their Penetration by Roots," Plant and Soil, IX, No.1). If roots are able to extend into the infiltration layer, it will increase the effective

STATISTICAL EVALUATION

Comment: The below detection limit data was not used appropriately in the statistical evaluation.

The data was re-evaluated in accordance with the comment and the new HHS published in the revised WQB Circular 7 (discussed above). As a result, the following have been identified as exceeding groundwater protection standards in existing monitoring wells:

Cadmium (mean only, well MW-A2)
Iron (mean and median, wells MW-A2 and MW-A3)
Cobalt (mean and median, wells MW-A2 and MW-A3)
Zinc (mean only, well MW-A2)
Sulfate (mean only, well MW-A2)

Chloroethane (mean and median, well MW-A3)
1,1-dichloroethane (mean and median, well MW-A2)
cis-1,2-dichloroethene (mean and median, well MW-A2)
1,1,1-trichloroethane (mean and median, well MW-A2)
Trichloroethene (mean and median, well MW-A2)
Vinyl chloride (mean and median, well MW-A2)

Details of the analysis will be included with the "Final Corrective Measures Assessment" report (or can be forwarded to you sooner if you would like them).

CONTAMINANT ASSESSMENT AND CONCEPTUAL SITE MODEL

Comment: The section needs to be revised to assess the volume of contaminants, the flow rate/rate of transport, contaminant attenuation, contributions from the Clark Tailings, and other factors. A plan to fill data gaps necessary to address these issues needs to be prepared and submitted for Department approval.

Some of these factors were addressed in our August 15, 1995, letter and will be included in the Final CMA report. A plan to fill additional data gaps is currently being prepared and will be forwarded soon. Part of this plan is the new monitoring wells discussed above (MW-A5, which has already been installed, and MW-A6, which is proposed in this letter). Once this plan is implemented, the data will be used to complete the conceptual site model in the Final CMA.

DEVELOPMENT AND SCREENING OF ALTERNATIVES

Comment: This section is deficient because of the RPOC issue. The section needs to be re-written to include treatment of groundwater alternatives.

We feel that at this time it is premature and inefficient to develop groundwater treatment alternatives until the RPOC issue has been resolved. Once the final RPOC has been determined,

the issue of whether or not GWPS are exceeded, or if there is the potential they will be exceeded, at or beyond the RPOC can be addressed. If GWPS are exceeded at the RPOC, then development and analysis of groundwater treatment alternatives will be appropriate and will be included in the Final CMA report.

REMEDY REQUIREMENTS

Comment: The Department will not accept the exclusion of potential remedies because of higher, but not prohibitive, costs. Also, two specific alternatives should be included for analysis: capping the entire landfill to 1993 standards and capping the landfill only, not the Clark Tailings, with a multi-media cap.

These comments will be considered and addressed in the Final CMA report. Once again, the issue of the RPOC must be resolved before a meaningful analysis of alternatives can be completed.

The Job Corps continues with capping procedures on areas filled before October 9, 1991. We plan to determine topsoil amendment requirements and an appropriate seed mix (as part of the plan to fill data gaps currently being prepared) so that we may seed areas which have been capped this fall. Also, as discussed above, we are preparing an updated "Closure Plan" and "CQA/CQC Plans" for areas which received waste after October 9, 1991. At this point, the most pressing matter is resolving the RPOC issue. We realize that in order to do this, we must complete the delineation of the plume and fill other data gaps, discussed above and in the Draft CMA report. Therefore, we will complete our plan for filling these data gaps and forward it as soon as possible for your review. We would like to proceed with the installation of the proposed well, MW-A6, as soon as we receive your response. If you have any questions or comments in the meantime, please give me a call at 782-5177.

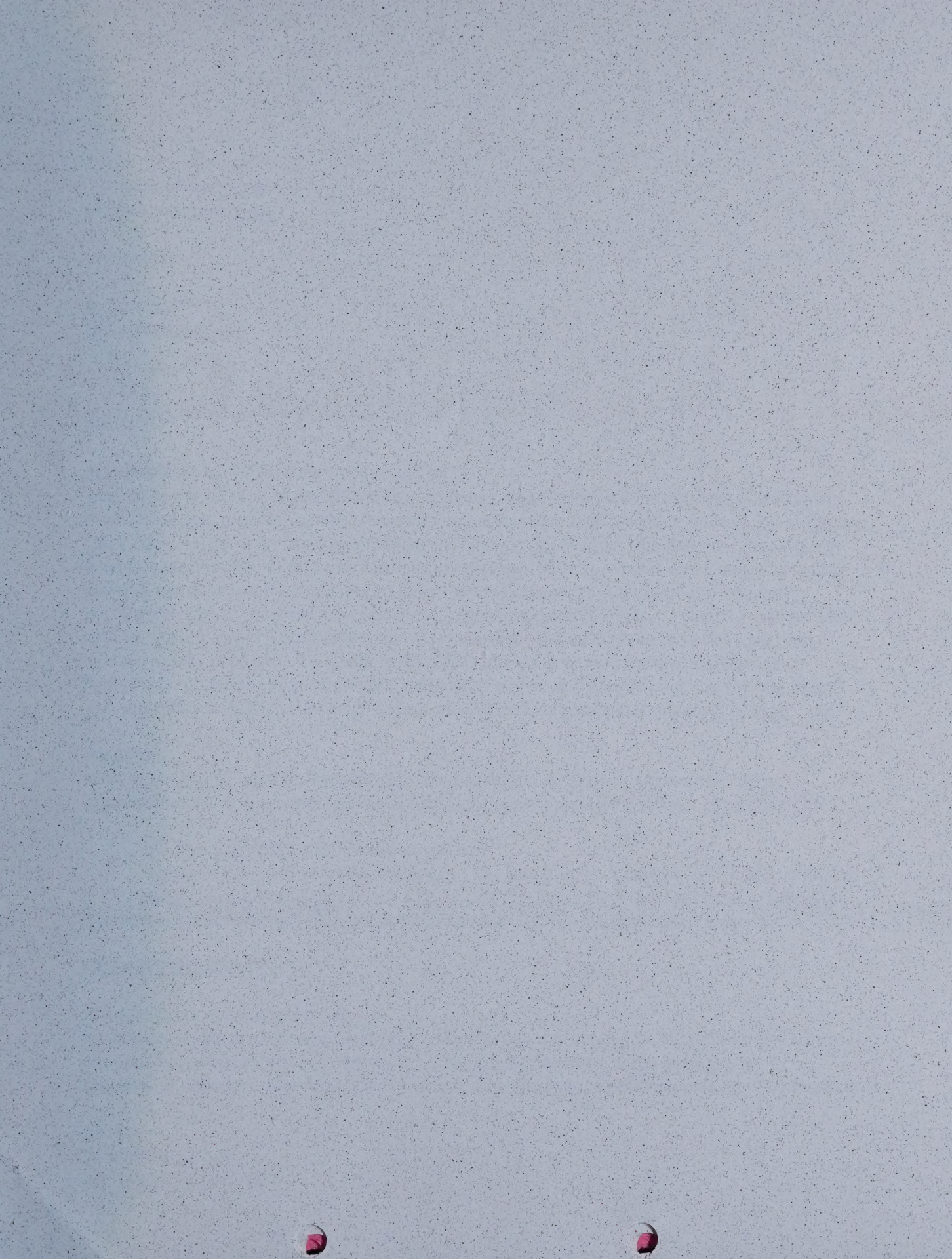
Sincerely,

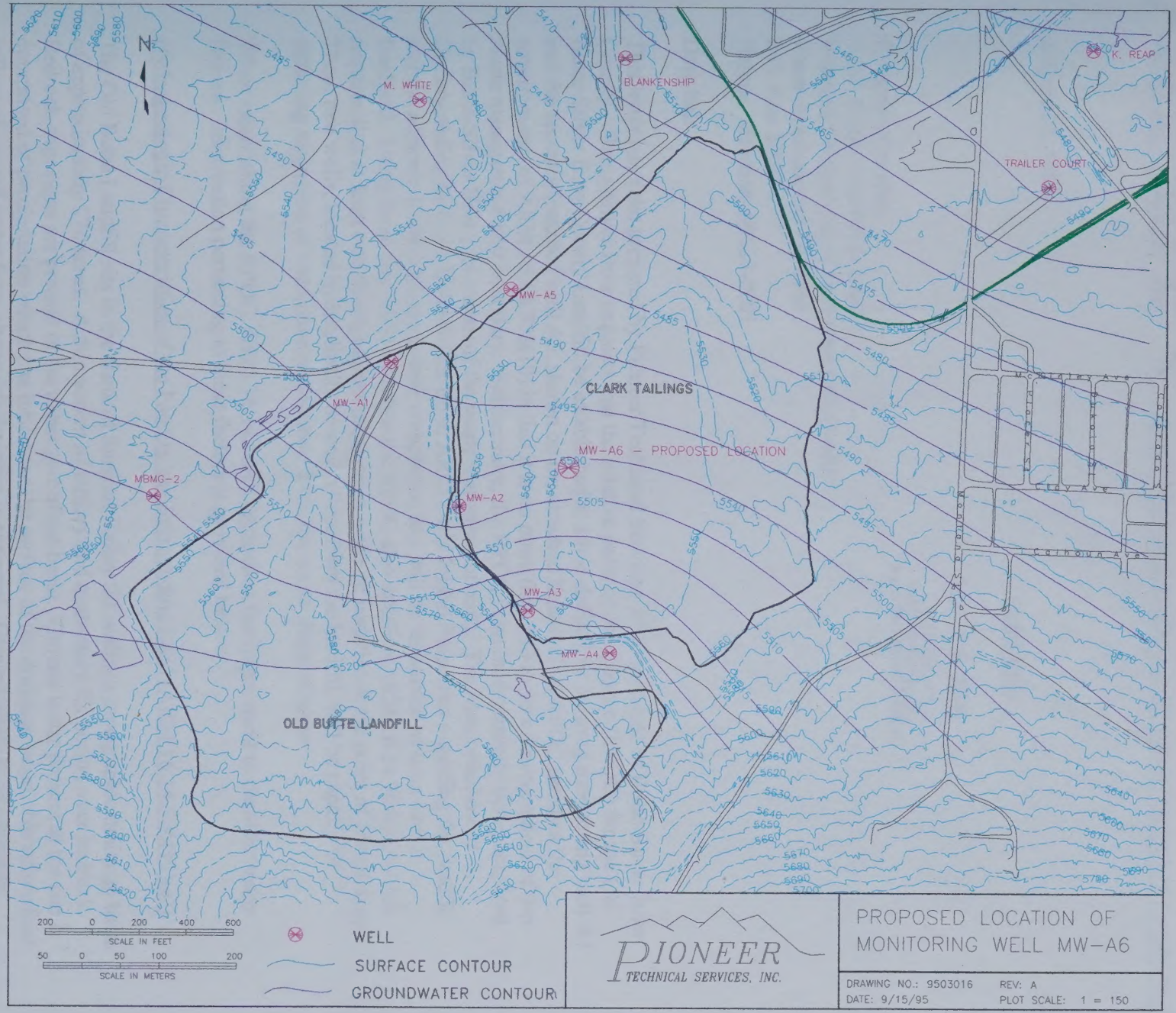
Brad Archibald

Brad Archibald, P.E.
Project Manager

Attachment

cc: Jim Johnston, BSB
Gary Keeler, BSB




N
M. WHITE
BLANKENSHIP
K. REAP
TRAILER COURT
MW-A5
MW-A1
CLARK TAILINGS
MW-A6 - PROPOSED LOCATION
MBMG-2
MW-A2
MW-A3
MW-A4
OLD BUTTE LANDFILL
200 0 200 400 600
SCALE IN FEET
50 0 50 100 200
SCALE IN METERS
WELL
SURFACE CONTOUR
GROUNDWATER CONTOUR
PIONEER
TECHNICAL SERVICES, INC.
PROPOSED LOCATION OF
MONITORING WELL MW-A6
DRAWING NO.: 9503016
REV: A
DATE: 9/15/95
PLOT SCALE: 1 = 150

PIONEER
TECHNICAL SERVICES, INC.
P.O. BOX 3445, BUTTE, MONTANA 59702 PHONE (406) 782-5177 FAX (406) 782-5866

August 15, 1995

RECEIVED
AUG 16 1995
Montana Department of
Environmental Quality
Waste Management Division

F. Patrick Crowley
Solid Waste Regulatory Lead
Montana Department of Environmental Quality
Waste Management Division
P.O. Box 200901
Helena, Montana 59620-0901

Dear Pat:

This letter has been prepared by Pioneer Technical Services, Inc., on behalf of Butte-Silver Bow County. Butte-Silver Bow requests that the relative point of compliance (RPOC) for the Old Butte-Silver Bow County Landfill be established at a line defined by existing monitoring well A1 and the recently installed well A5, shown on the attached figure. This RPOC satisfies the requirements of ARM 16.14.708(10) in that it is no more than 150 meters downgradient of the waste management unit boundary. Furthermore, the RPOC is on land currently being acquired by Butte-Silver Bow (the owner of the waste management unit). The Memorandum of Understanding between Butte-Silver Bow, ARCO, and Inland Properties regarding the landfill and the adjacent Clark Tailings is near completion and will be forwarded as soon as it is finalized. Using these two wells to define the RPOC also satisfies ARM 16.14.704(2), which requires that at least two downgradient monitoring wells be installed at the point of compliance. These two wells, located hydraulically downgradient from the landfill, will be capable of detecting migration of hazardous constituents from the waste disposal areas.

When establishing the RPOC, ARM 16.14.506(11) requires the Department to consider many factors. Information pertaining to these factors is provided below.

Hydrogeologic Characteristics of the Facility and Surrounding Land (ARM 16.14.506(11)(a))

The Old Butte Landfill sits in the flank of Summit Valley fill within a topographic drainage basin of approximately 270 acres. A thin veneer of tertiary and quaternary fill occurs over bedrock. Bedrock exposures are present in the upper part of the basin. Ground water present at the site is comprised of precipitation which has infiltrated the surface of the drainage basin. No subsurface inflow of ground water from above this drainage is expected. Ground water flow generally follows the surface topography to the north and northeast. At the outlet of the topographic drainage basin, ground water is discharged to and becomes part of the alluvial valley aquifer.

100% post-consumer paper & 100% vegetable based inks

Ground water flowing under the landfill is moving through layered deposits of weathered granite material that range in texture from clay to coarse sand. Most of the material is fine sand with minor silt and clay fractions. Clay and coarse sand occur as thin lenses in the fine sand. Based on an estimated gradient of 0.017 ft/ft (based on groundwater contours developed from elevations measured during the spring of 1995, shown on the attached figure), an estimated average hydraulic conductivity (k) of 1.0×10^{-3}cm/sec, and porosity of 0.3 for the aquifer, the groundwater flow velocity is calculated at 57.5 feet per year using Darcy's Law. This equates to an advective travel time from the proposed RPOC to Blankenship's of approximately 26 years. Note that the calculation is very sensitive to the estimated hydraulic conductivity of the aquifer materials. If this value is changed to 5.0×10^{-3}cm/sec, the estimated travel time changes to 5.2 years (or 287 feet per year). These values represent a reasonable range of hydraulic conductivities for the fine sands that comprise the aquifer. Preliminary results of an undisturbed sample from the saturated zone of the recently installed well (A5) estimate the hydraulic conductivity of the sampled aquifer materials at 2.8×10^{-7} (final results are not available at this time). If this value is used as the hydraulic conductivity of the aquifer, the ground water flow velocity is calculated at 0.016 feet per year; this equates to a travel time of 93,200 years to the Blankenship well. However, this sample was of a the finer aquifer materials sampled, and is most likely not representative of the entire aquifer. Nonetheless, the ground water flow velocities are expected to be in the range of 1 to 300 feet per year.

While lenses of materials with higher and lower hydraulic conductivities are present in the area of the landfill, the majority of subsurface soils appear to be comprised of the fine sands described above. Given this fact, the lateral spacing of wells A1 and A5 is adequate to detect any contaminants migrating from the waste management unit. The spacing of these wells is actually less than that of the existing spacing between A1 and A2 (approximately 550 feet compared to approximately 650 feet).

Volume and Physical Characteristics of Leachate (ARM 16.14.506(11)(b))

These data are necessary to determine if leakage from the facility will be detectable at the RPOC. Based on Hydrologic Evaluation Landfill Performance (HELP) model simulations, the landfill, under current conditions, produces an average of 1.7 million gallons of leachate per year (based on a 100-yr simulation). This 1.7 million gallons accounts for 18% of the total annual estimated contribution to ground water via infiltration of precipitation within the landfill's drainage basin. No chemical data for the landfill's leachate are available. However, data pertaining to typical municipal solid waste landfill data are useful in this case. According to the Solid Waste Association of North America (SWANA, 1991), landfill leachate typically contains high concentrations (on the order of hundreds of mg/L) of total organic carbon, chemical oxygen demand, magnesium, potassium, chlorides, and sulfates, among other constituents. These contaminants, as wells as any volatile or semi-volatile organic compounds escaping from the waste management unit, would be detectable at the proposed RPOC under the assessment

Proximity and Withdrawal Rate of Ground Water Users (ARM 16.14.506(11)(d))

The nearest downgradient ground water users are on the Blankenship property, shown on the attached figure. Residents of the M. White property are also water users, but are not considered downgradient of the waste management unit. Ground water flow is toward the Blankenship well. The Blankenship property is not a residence; it is a shop and storage area for a paving contractor (Blankenship Construction). In the shop area, approximately 1,500 feet downgradient (northeast) of the waste management unit, there are two wells. One of these wells is completed to a depth of 45 feet and the other well is completed to a depth greater than 100 feet (as determined by field measurements). These wells are used to provide water for construction activities and irrigation; it is not known if these wells are used as a potable water source in any way. Extraction rates from these wells are unknown. The shallower well is considered to be more susceptible to contamination from the landfill. The shallower well was sampled in April 1995. While chloromethane and 1,2-dichloroethane were detected in the well (at 3.0 and 1.2 parts per billion, respectively), no ground water protection standards were exceeded. Further downgradient, three cemetery wells extract ground water for irrigation purposes. Each of these wells is completed to a depth of 57 feet, based on field measurements. These wells are not a source of potable water. Extraction rates are not known. Some volatile organic compounds (including chloromethane, chloroform, 1,2-dichloroethane, and tetrachlorethene) were detected in the "Crematorium" and "Cemetery Middle" wells (sampled in spring 1995), but no ground water protection standards were exceeded. All organic constituents detected in the cemetery wells were below quantitation limits (identified in the Draft "Corrective Measures Assessment" with a "J" qualifier) with the exception of chloromethane. Analytical data are detailed in Section 5 of the Draft "Corrective Measures Assessment."

The proposed RPOC lies directly between the waste management unit and the nearest downgradient water user. Any exceedence of ground water protection standards caused by contaminants migrating from the landfill will be detected at the RPOC before it is able to migrate to the downgradient water user.

Availability of Alternative Drinking Water Supplies (ARM 16.14.506(11)(e))

Alternative drinking water supplies, if necessary, are readily available in the vicinity of the waste management unit and the downgradient ground water users. Bottled drinking water may be provided to downgradient water users via a local purveyor, if necessary. Alternatively, there is a Butte-Silver Bow-owned water distribution main at Montana Street, approximately 1,500 feet east of the Blankenship property; it is feasible to supply an alternative water source, either temporarily or permanently, from this water main. Butte-Silver Bow is committed to supply an alternative source of drinking water to all effected downgradient ground water users should Safe Drinking Water Act MCLs be exceeded due to migration of contaminants from the landfill.

Existing Quality of Ground Water (ARM 16.14.506(11)(f))

Existing ground water quality was discussed above (under Quantity , Quality, and Direction of Flow of Ground Water). Contaminants have been detected downgradient of the site, but no MCLs have been exceeded. Upgradient of the site, none of the organic Contaminants of Concern (CoC) at the site (as identified in the Draft "Corrective Measures Assessment: 1,1-dichloroethane; cis-1,2-dichloroethene; tetrachloroethene; trichlorethene; and vinyl chloride) were detected in the upgradient monitoring well, MBMG-2. Inorganic CoC are present in the background monitoring well at concentrations that do not indicate any degradation by anthropogenic activity. No ground water protection standards are exceeded in the background well (MBMG-2). As discussed above and in the Draft "Corrective Measures Assessment," thallium is detected in the well above it's MCL, but is believed to be a laboratory contaminant.

Ground water quality upgradient of the waste management unit is adequate to be used as a water source; however, this aquifer is unlikely to be developed as a potable ground water source because of ownership (Butte-Silver Bow) and zoning restrictions. Downgradient of the proposed RPOC, ground water quality is adequate for use a water source (as exhibited by the ground water quality in the Blankenship and cemetery wells).

Ground water quality beneath the landfill has been degraded to levels that make the water unusable as a potable water source, as exhibited by the data from wells A2 and A3. Butte-Silver Bow, through the Butte-Silver Bow Water Quality District and deed restrictions, will place ground water use restrictions on the aquifer beneath the landfill (up to the proposed RPOC) and the adjacent Clark Tailings. These restrictions will prevent the use of the ground water as a potable water source. If it becomes necessary because of migration of contaminants from the landfill, the boundaries of the restrictions will be expanded to include all ground water that has been degraded to the extent that it does not meet MCLs. Butte-Silver Bow will not allow the use of any ground waters contaminated by the landfill in any manner which may pose a threat to human health or the environment. If necessary, Butte-Silver Bow will provide an alternative drinking water source to any downgradient water users, as described above.

Public Health, Safety, and Welfare Effects (ARM 16.14.506(11)(g))

Moving the RPOC to the point proposed will have no adverse effects on the public health, safety, and welfare. Contamination leaving the landfill will be detected at the RPOC before it reaches downgradient water users. The proposed RPOC will detect the contaminants moving in the direction of downgradient water users better than the existing RPOC, defined by wells A1, A2, A3, and A4. The new RPOC is hydraulically downgradient from the landfill, while the existing RPOC is actually the border of the landfill on the north and east. This RPOC is not indicative of ground water quality migrating from the waste management unit; instead, it is indicative of ground water quality directly beneath and/or within the waste management unit. While these data are helpful in determining if ground water contamination has occurred directly below the

landfill, it does not help in determining if contamination is migrating from the site and posing a potential threat to downgradient water users. The proposed RPOC will better serve the purpose of determining if ground water contamination has the potential to migrate beyond the waste management unit boundary and effect the public health, safety, and welfare.

If a release is detected at the proposed RPOC, there will be adequate time available to respond before ground water protection standards are exceeded at the wells used by downgradient users. The nearest downgradient well is approximately 1,500 feet from the proposed RPOC. Data from the nearest downgradient well shows that contaminants present at the landfill are present at the well, but at levels well below MCLs or HHSs. (It should be noted that the source of the contamination in the Blankenship well cannot be attributed for certain to the landfill, given the industrial nature of activities at the Blankenship facility.) While the exact groundwater travel time between the proposed RPOC and the downgradient wells is not known at this time, it is not significantly different than the travel time between the current RPOC and the nearest downgradient well. This is based on the estimated groundwater velocities discussed previously. Response time would not be compromised significantly by moving the RPOC to the proposed location.

In summary, moving the RPOC to the proposed location will better represent the quality of ground water migrating from the waste management unit. The proposed RPOC meets the requirements of ARM 16.14.708(10). If you have any questions on this request, please contact me at 782-5177. We look forward to your response.

Sincerely,

Brad Archibald

Brad Archibald, P.E.
Project Manager

Attachments

cc: Jim Johnston, BSB
Gary Keeler, BSB

WASHINGTON ST.
TOWN PUMP
CEMETERY MIDDLE
CEMETERY EAST
CREMATORIUM
M. WHITE
BLANKENSHIP
K. REAP
TRAILER COURT
MW-A5
MW-A1
CLARK TAILINGS
MBMG-2
MW-A2
MW-A3
MW-A4
OLD BUTTE LANDFILL
WELL
SURFACE CONTOUR
GROUNDWATER CONTOUR
SCALE IN FEET
SCALE IN METERS
PIONEER
TECHNICAL SERVICES, INC.
WELL LOCATIONS AND
GROUNDWATER CONTOUR MAP
DRAWING NO.: 9503015
REV: A
DATE: 8/15/95
PLOT SCALE: 1 = 150

File: Old Butte ground water.

BUTTE-SILVER BOW
DEPARTMENT OF PUBLIC WORKS
Courthouse
Butte, Montana 59701
Phone: (406) 723-8262

Verbal approval given Ap 28, 1995
Pat Crowley

RECEIVED
APR 28 1995
Montana Department of Health
and Environmental Sciences
Waste Management Division

April 28, 1995

Mr. Pat Crowley
Department of Health and Environmental Sciences
Solid and Hazardous Waste Bureau
P.O. Box 200901
Helena, MT 59620-0901

Dear Pat:

I am requesting a two week extension on Butte-Silver Bow's Assessment Report at the Old Landfill to allow for sampling results.

Thank you for your attention to this request.

Sincerely,

James E. Johnston, Director
Public Works Department

pb

RECEIVED
APR 2 8 1995
Montana Department of Health
and Environmental Sciences
Waste Management Section

CLOSED
BUTTE-SILVER BOW LANDFILL
LICENSE NUMBER 20

PIONEER TECHNICAL SERVICES

GROUNDWATER SAMPLING, MARCH 1995

APRIL 1995

IS LOCATED IN THE GROUNDWATER MONITORING REPORTS ARCHIVE, BOX NUMBER 7

RECEIVED 4/25/1995

MONTANA TECH
of The University of Montana

Montana Bureau of Mines and Geology
1300 West Park Street
Butte, Montana 59701-8997
(406) 496-4180

Site/O.U.
DHES File #
Admin. Record: Yes No
Administrative Record #
Confidential: Yes No
Key Words/Comments:
original in Superfund Files
4-03-04-19

April 3, 1995

Mr. Brad Archibald
Pioneer Technical Services, Inc.
P.O. Box 3445
Butte, MT 59702

Dear Brad:

Enclosed are copies of water quality data from surface water samples collected by the Montana Bureau of Mines and Geology (MBMG). Sites sampled were Grove Creek, Silver Bow Creek, Blacktail Creek, and Missoula Gulch.

This data is from the Grove Creek report you called inquiring about. As I mentioned at that time, this report is still in Draft stage, however, in discussions with Jim Scott, MDHES, he has approved the release of the analytical data, which I believe was your main interest.

I hope you find the enclosed data helpful. Do not hesitate to call if you have further questions.

Sincerely,

Ted Duaime
Hydrogeologist

Enclosures
c: Jim Scott, MDHES

TD/bb

RECEIVED
APR 05 1995
Montana Department of Health
and Environmental Sciences
ERD/Superfund

				PHYSICAL PARAMETERS														
				FIELD					LAB				PERCENT MEQ/L					
	DATE	TIME	FLOW	FLOW	SC	pH	Eh	TEMP	SC	PH	HARDNESS	ALKALINITY						
	(MM/DD/YR)	(HRS)	(CFS)	(GPM)	(UMHOS)		(mv)	(C)	(UMHOS)		(MG/L)	(MG/L)	Ca	Mg	Na	HCO3	CO3	SO4
BLACKTAIL CREEK AT FATHER SHEEHAN PARK																		
GC-6	5/15/1991	18:10	15.8	7110	180	7.7	257.3	12.8	196	7.5	76.5	55.0	58.4	21.7	16.2	62.1	.0	30.8
	3/ 6/1992	14:25	7.1	3195	234	7.4	236.0	9.1	255	7.9	96.7	83.4	56.2	23.8	16.9	66.7	.0	26.9
	6/19/1992	14:00	3.5	1589	310	7.7	257.0	22.7	280	8.0	103.4	98.4	55.8	24.2	17.8	70.1	.0	24.2
	8/20/1992	14:10	2.3	1030	305	7.5	-46.8	15.8	313	7.9	126.8	109.9	57.2	23.2	17.6	71.6	.0	23.4
BLACKTAIL CREEK ABOVE CONFLUENCE WITH GROVE CREEK																		
GC-5	5/15/1991	17:00	20.2	9090	280	7.6	288.1	15.5	233	7.5	87.8	66.1	58.7	20.9	17.1	62.3	.0	30.0
	3/ 6/1992	15:00	9.3	4185	248	7.7	262.2	10.5	278	7.9	106.2	96.5	56.5	23.6	17.1	68.6	.0	24.8
	6/19/1992	14:50	7.8	3510	425	7.7	246.0	25.3	340	7.8	137.5	110.7	56.6	23.5	17.9	66.1	.0	26.7
	8/20/1992	17:00	6.3	2841	327	7.1	-31.3	18.5	354	7.7	136.7	113.2	57.8	22.5	17.0	67.0	.0	25.3
GROVE CREEK (ABOVE BSB LANDFILL)																		
GC-1	5/15/1991	11:10	.7	315	295	8.1	96.5	9.5	340	7.8	130.1	78.2	55.9	21.0	19.6	51.1	.0	42.2
	3/ 6/1992	10:41	.4	180	276	8.2	27.4	3.3	297	7.6	106.5	73.6	54.3	21.3	18.2	50.9	.0	42.5
	6/19/1992	11:12	.2	68	360	7.6	249.3	17.0	420	7.9	181.1	132.1	60.1	21.5	15.9	61.8	.0	33.1
	8/20/1992	12:40	.0	2	372	7.7	-66.5	19.0	424	8.2	167.9	150.9	57.8	21.4	16.9	70.9	.0	25.3
GROVE CREEK (BELOW BSB LANDFILL, @ MT ST)																		
GC-2	5/15/1991	12:30	1.1	495	440	7.6	138.8	11.7	430	7.4	167.4	115.2	56.7	21.1	18.8	54.3	.0	35.5
	3/ 6/1992		.4	180	385	8.1	N/A	6.5	408	7.6	152.9	107.3	56.4	21.4	17.3	53.0	.0	37.4
	6/19/1992	11:23	.3	135	469	7.3	229.1	16.9	510	7.5	213.3	162.3	57.3	22.7	16.9	61.2	.0	27.8
	8/20/1992	13:00	.0	22	540	7.2	-26.9	12.1	580	7.6	232.0	192.7	58.1	22.3	16.7	64.4	.0	23.3
GROVE CREEK ABOVE CONFLUENCE WITH BLACKTAIL CREEK																		
GC-3	5/15/1991	13:50	.2	90	460	7.7	243.8	17.4	470	7.9	181.3	124.5	55.2	20.4	20.6	52.9	.0	35.7
	3/ 6/1992	13:05	.1	45	476	7.8	129.8	6.5	490	7.5	180.0	122.5	55.2	20.9	19.1	50.5	.0	37.0
	6/19/1992	16:00	N/A	N/A	770	7.1	113.0	25.3	880	7.4	326.1	276.6	50.8	20.8	24.3	58.5	.0	26.4
	8/20/1992	13:30	.0	3	490	7.0	-18.8	15.0	510	7.0	176.5	78.1	54.3	17.8	19.8	33.0	.0	48.8
BLACKTAIL CREEK ABOVE CONFLUENCE WITH SBC (USGS GAGE)																		
GC-4	5/15/1991	15:06	19.1	8595	240	7.9	305.8	13.0	248	7.6	99.0	71.9	58.2	21.9	16.8	62.5	.0	29.4
SS-04	3/ 6/1992	15:30	11.0	4950	305	7.8	244.7	9.1	327	7.8	126.3	96.3	56.2	23.0	18.0	61.6	.0	30.5
	6/19/1992	13:40	19.4	8730	412	7.7	244.0	23.5	359	8.1	141.5	121.3	56.6	23.2	17.9	66.8	.0	25.8
	8/21/1992	09:30	13.0	5850	346	7.4	-36.5	12.4	386	7.5	160.2	123.0	58.0	22.6	16.9	64.5	.0	27.7
	6/12/1992	07:00	10.0	4500	360	7.4	N/A	18.9	412	7.4	152.4	117.0	55.2	21.6	19.1	60.5	.0	30.2
SILVER BOW CREEK AT TEXAS AVE. (METRO STORM DRAIN)																		
SS-02	6/11/1992	16:30	.0	0	180	6.8	N/A	19.1	212	6.7	82.5	26.2	73.7	9.1	12.5	27.4	.0	62.1
SILVER BOW CREEK BELOW CONFLUENCE WITH BLACKTAIL CR. (@ MT ST)																		
TM-01	6/12/1992	07:30	N/A	N/A	440	7.1	N/A	19.5	724	7.3	165.0	107.0	57.1	21.3	17.8	53.2	.0	37.8
	6/19/1992	09:43	10.4	4680	387	7.6	239.7	13.3	404	7.8	156.6	116.5	56.0	23.7	18.2	58.4	.0	34.3
	8/20/1992	11:50	15.4	6930	377	6.7	-14.2	13.4	394	7.4	161.8	93.5	60.8	21.6	15.0	49.1	.0	43.9
MISSOULA GULCH (@ CENTENNIAL AVE.)																		
TM-02	6/11/1992	17:45	N/A	N/A	510	7.4	N/A	18.0	561	7.5	230.4	92.4	64.7	19.4	13.7	33.8	.0	56.1
	6/20/1992	11:00	.6	251	424	6.1	13.1	14.1	458	7.1	172.2	29.5	61.7	24.8	10.5	13.6	.0	80.8
SILVER BOW CREEK BELOW COLORADO TAILINGS (@ USGS GAGE)																		
SS-07	6/12/1992	08:00	19.0	8550	480	7.2	N/A	17.9	548	7.2	182.4	111.8	54.1	18.5	21.5	41.6	.0	46.3
	6/19/1992	12:55	20.0	9000	605	7.1	309.7	19.5	530	7.4	169.2	97.6	51.3	20.7	24.8	41.4	.0	45.4
	8/21/1992	09:45	17.0	7650	400	7.1	-21.5	15.9	540	7.4	183.4	117.3	50.9	21.0	24.8	47.0	.0	39.8

N/A - NOT ANALYIZED

					PHYSICAL PARAMETERS																		
					FIELD				LAB														
	DATE	TIME	FLOW	FLOW	SC	pH	Eh	TEMP	SC	PH	Ca	Mg	Na	K	Fe	Mn	SiO2	HCO3	CO3	Cl	SO4	NO3-N	F
	(MM/DD/YR)	(HRS)	(CFS)	(GPM)	(UMHOS)		(mv)	(C)	(UMHOS)		(MG/L)	(MG/L)	(MG/L)	(MG/L)	(MG/L)	(MG/L)	(MG/L)	(MG/L)	(MG/L)	(MG/L)	(MG/L)	(MG/L)	(MG/L)
BLACKTAIL CREEK AT FATHER SHEEHAN PARK																							
GC-6	5/15/1991	18:10	15.8	7110	180	7.7	257.3	12.8	196	7.5	22.3	5.0	7.1	2.8	.58	.02	18.6	67.1	.0	4.5	26.2	.35	.32
	3/ 6/1992	14:25	7.1	3195	234	7.4	236.0	9.1	255	7.9	27.2	7.0	9.4	2.9	.17	.06	25.2	101.7	.0	5.6	32.3	.79	.34
	6/19/1992	14:00	3.5	1589	310	7.7	257.0	22.7	280	8.0	28.9	7.6	10.6	2.2	.08	.02	25.1	120.0	.0	5.4	32.9	.82	.41
	8/20/1992	14:10	2.3	1030	305	7.5	-46.8	15.8	313	7.9	36.1	8.9	12.7	2.4	.07	.02	28.3	134.0	.0	5.4	34.5	1.31	.61
BLACKTAIL CREEK ABOVE CONFLUENCE WITH GROVE CREEK																							
GC-5	5/15/1991	17:00	20.2	9090	280	7.6	288.1	15.5	233	7.5	25.9	5.6	8.7	2.9	.48	.03	20.0	80.6	.0	5.8	30.6	.79	.33
	3/ 6/1992	15:00	9.3	4185	248	7.7	262.2	10.5	278	7.9	30.0	7.6	10.4	2.9	.15	.04	26.7	117.6	.0	6.6	33.4	1.26	.36
	6/19/1992	14:50	7.8	3510	425	7.7	246.0	25.3	340	7.8	38.9	9.8	14.1	2.7	.06	.02	29.0	135.0	.0	8.5	42.9	1.83	.39
	8/20/1992	17:00	6.3	2841	327	7.1	-31.3	18.5	354	7.7	39.4	9.3	13.3	3.5	.06	.02	26.8	138.0	.0	9.2	41.0	1.98	.67
GROVE CREEK (ABOVE BSB LANDFILL)																							
GC-1	5/15/1991	11:10	.7	315	295	8.1	96.5	9.5	340	7.8	37.9	8.6	15.3	4.7	.15	.06	23.9	95.4	.0	7.3	62.1	.15	.54
	3/ 6/1992	10:41	.4	180	276	8.2	27.4	3.3	297	7.6	30.6	7.3	11.8	6.8	.25	.17	1.0	90.0	.0	6.7	59.2	.23	.50
	6/19/1992	11:12	.2	68	360	7.6	249.3	17.0	420	7.9	53.4	11.6	16.2	4.3	.07	.09	36.0	161.0	.0	7.8	67.9	.07	1.22
	8/20/1992	12:40	.0	2	372	7.7	-66.5	19.0	424	8.2	49.1	11.0	16.5	6.4	.10	.04	36.0	184.0	.0	5.7	51.6	<0.1	.54
GROVE CREEK (BELOW BSB LANDFILL, @ MT ST)																							
GC-2	5/15/1991	12:30	1.1	495	440	7.6	138.8	11.7	430	7.4	48.9	11.0	18.6	5.6	.60	.83	24.9	140.5	.0	15.4	72.3	.10	.78
	3/ 6/1992		.4	180	385	8.1	N/A	6.5	408	7.6	44.4	10.2	15.6	7.5	.53	.76	25.6	130.8	.0	13.8	72.6	.36	.67
	6/19/1992	11:23	.3	135	469	7.3	229.1	16.9	510	7.5	61.2	14.7	20.7	6.6	.18	1.54	28.2	197.9	.0	20.7	70.9	.05	1.00
	8/20/1992	13:00	.0	22	540	7.2	-26.9	12.1	580	7.6	67.2	15.6	22.1	6.6	2.55	3.93	34.8	235.0	.0	26.0	67.0	1.28	.69
GROVE CREEK ABOVE CONFLUENCE WITH BLACKTAIL CREEK																							
GC-3	5/15/1991	13:50	.2	90	460	7.7	243.8	17.4	470	7.9	53.0	11.9	22.6	7.1	.34	.31	1.0	151.8	.0	19.0	80.8	.23	.92
	3/ 6/1992	13:05	.1	45	476	7.8	129.8	6.5	490	7.5	52.3	12.0	20.8	8.8	.51	1.86	25.0	149.3	.0	21.5	86.3	.36	1.00
	6/19/1992	16:00	N/A	N/A	770	7.1	113.0	25.3	880	7.4	92.7	23.0	51.0	14.7	.30	2.35	36.6	337.2	.0	50.4	120.0	<0.1	2.69
	8/20/1992	13:30	.0	3	490	7.0	-18.8	15.0	510	7.0	53.2	10.6	22.2	15.4	.23	2.42	22.6	95.2	.0	30.6	111.0	3.01	.66
BLACKTAIL CREEK ABOVE CONFLUENCE WITH SBC (USGS GAGE)																							
GC-4	5/15/1991	15:06	19.1	8595	240	7.9	305.8	13.0	248	7.6	28.8	6.6	9.5	3.0	.47	.05	20.1	87.6	.0	6.6	32.4	.90	.38
SS-04	3/ 6/1992	15:30	11.0	4950	305	7.8	244.7	9.1	327	7.8	35.9	8.9	13.2	3.5	.15	.96	27.4	117.4	.0	8.8	45.7	1.28	.44
	6/19/1992	13:40	19.4	8730	412	7.7	244.0	23.5	359	8.1	40.2	10.0	14.6	3.1	.13	.08	26.6	147.9	.0	9.5	45.0	<0.1	.52
	8/21/1992	09:30	13.0	5850	346	7.4	-36.5	12.4	386	7.5	46.2	10.9	15.4	4.0	.08	.09	31.7	150.0	.0	10.6	50.7	2.10	.59
	6/12/1992	07:00	10.0	4500	360	7.4	N/A	18.9	412	7.4	43.9	10.4	17.4	6.4	.18	.19	26.5	142.6	.0	12.7	56.0	3.18	.77
SILVER BOW CREEK AT TEXAS AVE. (METRO STORM DRAIN)																							
SS-02	6/11/1992	16:30	.0	0	180	6.8	N/A	19.1	212	6.7	29.4	2.2	5.7	3.7	.04	.61	6.7	32.0	.0	7.1	56.9	1.32	1.43
SILVER BOW CREEK BELOW CONFLUENCE WITH BLACKTAIL CR. (@ MT ST)																							
TM-01	6/12/1992	07:30	N/A	N/A	440	7.1	N/A	19.5	724	7.3	48.1	10.9	17.2	6.1	.16	.41	26.8	130.5	.0	12.8	72.9	2.58	.84
	6/19/1992	09:43	10.4	4680	387	7.6	239.7	13.3	404	7.8	44.1	11.3	16.4	3.3	.07	.36	26.3	142.0	.0	10.3	65.7	1.45	.60
	8/20/1992	11:50	15.4	6930	377	6.7	-14.2	13.4	394	7.4	47.8	10.3	13.5	4.0	.09	.50	23.4	114.0	.0	9.5	80.3	1.73	.93
MISSOULA GULCH (@ CENTENNIAL AVE.)																							
TM-02	6/11/1992	17:45	N/A	N/A	510	7.4	N/A	18.0	561	7.5	71.0	12.9	17.3	4.8	.01	1.57	22.7	112.6	.0	19.5	147.0	3.56	1.26
	6/20/1992	11:00	.6	251	424	6.1	13.1	14.1	458	7.1	49.2	12.0	9.6	4.7	.01	4.25	14.5	36.0	.0	8.7	169.0	1.29	1.11
SILVER BOW CREEK BELOW COLORADO TAILINGS (@ USGS GAGE)																							
SS-07	6/12/1992	08:00	19.0	8550	480	7.2	N/A	17.9	548	7.2	54.4	11.3	24.8	11.5	.31	1.58	22.5	136.3	.0	23.0	119.5	5.82	.91
	6/19/1992	12:55	20.0	9000	605	7.1	309.7	19.5	530	7.4	48.3	11.8	26.8	5.9	.16	1.25	26.3	119.0	.0	22.0	102.6	.96	.70
	8/21/1992	09:45	17.0	7650	400	7.1	-21.5	15.9	540	7.4	52.0	13.0	29.0	6.6	.13	.96	25.3	143.0	.0	23.3	95.3	3.80	.65

N/A - NOT ANALYZED

					PHYSICAL PARAMETERS						DISSOLVED CONCENTRATION												
				FIELD					LAB														
	DATE	TIME	FLOW	FLOW	SC	pH	Eh	TEMP	SC	PH	Al	Ag	As	B	Ba	Be	Cd	Cr	Cu	Li	Pb	Sr	Zn
	(MM/DD/YR)	(HRS)	(CFS)	(GPM)	(UMHOS)		(mv)	(C)	(UMHOS)		(UG/L)	(UG/L)	(UG/L)	(UG/L)	(UG/L)	(UG/L)	(UG/L)	(UG/L)	(UG/L)	(UG/L)	(UG/L)	(UG/L)	(UG/L)
BLACKTAIL CREEK AT FATHER SHEEHAN PARK																							
GC-6	5/15/1991	18:10	15.8	7110	180	7.7	257.3	12.8	196	7.5	348	<4	6.1	<40	31	N/A	<5	<5	20	4	<40	135	<6
	3/ 6/1992	14:25	7.1	3195	234	7.4	236.0	9.1	255	7.9	<100	<6	3.0	<100	N/A	N/A	<1	<6	5	6	<1	168	8
	6/19/1992	14:00	3.5	1589	310	7.7	257.0	22.7	280	8.0	<100	<10	5.2	<100	N/A	N/A	<6	<10	<10	<6	<100	187	<10
	8/20/1992	14:10	2.3	1030	305	7.5	-46.8	15.8	313	7.9	<50	<1	3.3	<100	56.9	<0.5	<2	<2	4	<6	<3	225	12
BLACKTAIL CREEK ABOVE CONFLUENCE WITH GROVE CREEK																							
GC-5	5/15/1991	17:00	20.2	9090	280	7.6	288.1	15.5	233	7.5	331	<4	5.5	70	32	N/A	<5	<5	19	4	<40	149	4
	3/ 6/1992	15:00	9.3	4185	248	7.7	262.2	10.5	278	7.9	<100	<6	3.0	<100	N/A	N/A	<1	<6	5	<6	<1	185	9
	6/19/1992	14:50	7.8	3510	425	7.7	246.0	25.3	340	7.8	<100	<10	4.9	<100	N/A	N/A	<6	<10	<10	8	<100	240	7
	8/20/1992	17:00	6.3	2841	327	7.1	-31.3	18.5	354	7.7	<100	<1	3.3	<100	54.1	<0.5	<2	<2	9	<6	<3	228	26
GROVE CREEK (ABOVE BSB LANDFILL)																							
GC-1	5/15/1991	11:10	.7	315	295	8.1	96.5	9.5	340	7.8	<40	<4	5.3	130	35	N/A	5	<5	21	12	<40	228	176
	3/ 6/1992	10:41	.4	180	276	8.2	27.4	3.3	297	7.6	<100	<6	8.0	131	N/A	N/A	<1	<6	11	<6	1	191	20
	6/19/1992	11:12	.2	68	360	7.6	249.3	17.0	420	7.9	<100	<10	6.9	<100	N/A	N/A	<6	<10	12	20	<100	311	<10
	8/20/1992	12:40	.0	2	372	7.7	-66.5	19.0	424	8.2	<100	<1	6.4	<100	50.3	<0.5	<2	<2	18	<6	<3	272	20
GROVE CREEK (BELOW BSB LANDFILL, @ MT ST)																							
GC-2	5/15/1991	12:30	1.1	495	440	7.6	138.8	11.7	430	7.4	258	<4	7.2	125	38	N/A	<5	<5	19	9	<40	280	53
	3/ 6/1992		.4	180	385	8.1	N/A	6.5	408	7.6	<100	<6	7.0	<100	N/A	N/A	<1	<6	5	6	<1	249	30
	6/19/1992	11:23	.3	135	469	7.3	229.1	16.9	510	7.5	<100	<10	10.0	<100	N/A	N/A	<6	<10	<10	7	<100	350	20
	8/20/1992	13:00	.0	22	540	7.2	-26.9	12.1	580	7.6	<100	<1	14.7	<100	67.9	<0.5	<2	<2	2	<6	<1	376	36
GROVE CREEK ABOVE CONFLUENCE WITH BLACKTAIL CREEK																							
GC-3	5/15/1991	13:50	.2	90	460	7.7	243.8	17.4	470	7.9	249	8	12.0	40	34	N/A	<5	<5	44	10	<40	302	37
	3/ 6/1992	13:05	.1	45	476	7.8	129.8	6.5	490	7.5	<100	<6	10.0	<100	N/A	N/A	<1	<6	24	7	<1	310	117
	6/19/1992	16:00	N/A	N/A	770	7.1	113.0	25.3	880	7.4	<100	12	17.6	228	N/A	N/A	<6	<10	<10	<6	<100	590	19
	8/20/1992	13:30	.0	3	490	7.0	-18.8	15.0	510	7.0	<100	<1	19.6	210	48.6	<0.5	<2	<2	50	7	3	252	759
BLACKTAIL CREEK ABOVE CONFLUENCE WITH SBC (USGS GAGE)																							
GC-4	5/15/1991	15:06	19.1	8595	240	7.9	305.8	13.0	248	7.6	127	<4	6.4	<40	37	N/A	<5	<5	9	5	<40	164	<6
SS-04	3/ 6/1992	15:30	11.0	4950	305	7.8	244.7	9.1	327	7.8	<100	<6	6.0	<100	N/A	N/A	<1	<6	4	7	<1	215	15
	6/19/1992	13:40	19.4	8730	412	7.7	244.0	23.5	359	8.1	<100	<10	8.5	<100	N/A	N/A	<6	<10	<10	<6	<100	243	<10
	8/21/1992	09:30	13.0	5850	346	7.4	-36.5	12.4	386	7.5	<100	<10	5.3	<100	58.7	<0.5	<2	<6	5	<6	<1	267	40
	6/12/1992	07:00	10.0	4500	360	7.4	N/A	18.9	412	7.4	<50	<6	17.2	<100	N/A	N/A	<6	<6	33	<6	<50	265	92
SILVER BOW CREEK AT TEXAS AVE. (METRO STORM DRAIN)																							
SS-02	6/11/1992	16:30	.0	0	180	6.8	N/A	19.1	212	6.7	<50	<6	10.2	<100	N/A	N/A	<6	<6	605	<6	<50	59	1050
SILVER BOW CREEK BELOW CONFLUENCE WITH BLACKTAIL CR. (@ MT ST)																							
TM-01	6/12/1992	07:30	N/A	N/A	440	7.1	N/A	19.5	724	7.3	<50	<6	15.5	<100	N/A	N/A	<6	<6	105	6	<50	287	556
	6/19/1992	09:43	10.4	4680	387	7.6	239.7	13.3	404	7.8	<100	10	7.5	<100	N/A	N/A	<6	<10	<10	<6	<100	274	318
	8/20/1992	11:50	15.4	6930	377	6.7	-14.2	13.4	394	7.4	70	<1	4.3	220	49.7	<0.5	5	<1	311	<6	2	247	1261
MISSOULA GULCH (@ CENTENNIAL AVE.)																							
TM-02	6/11/1992	17:45	N/A	N/A	510	7.4	N/A	18.0	561	7.5	<50	<6	4.5	150	N/A	N/A	9	<6	50	10	<50	368	2280
	6/20/1992	11:00	.6	251	424	6.1	13.1	14.1	458	7.1	42	<1	<1	204	41.7	<0.5	30	<2	526	7	<3	249	8520
SILVER BOW CREEK BELOW COLORADO TAILINGS (@ USGS GAGE)																							
SS-07	6/12/1992	08:00	19.0	8550	480	7.2	N/A	17.9	548	7.2	<50	<6	23.0	120	N/A	N/A	<6	<6	322	8	<50	304	2090
	6/19/1992	12:55	20.0	9000	605	7.1	309.7	19.5	530	7.4	<100	<10	12.7	130	N/A	N/A	<6	<10	192	11	<100	300	1620
	8/21/1992	09:45	17.0	7650	400	7.1	-21.5	15.9	540	7.4	<100	<10	11.3	180	34.7	4	2	<6	94	<6	1	316	942

N/A - NOT ANALYIZED

					PHYSICAL PARAMETERS						DISSOLVED METAL LOADING RATE, POUNDS PER DAY						
	DATE	TIME	FLOW	FLOW	FIELD SC	pH	Eh	TEMP	LAB SC	PH	Fe	Mn	SO4	Al	As	Cu	Zn
	(MM/DD/YR)	(HRS)	(CFS)	(GPM)	(UMHOS)		(mv)	(C)	(UMHOS)		(lb/d)	(lb/d)	(lb/d)	(lb/d)	(lb/d)	(lb/d)	(lb/d)
BLACKTAIL CREEK AT FATHER SHEEHAN PARK																	
GC-6	5/15/1991	18:10	15.8	7110	180	7.7	257.3	12.8	196	7.5	49.56	2.04	2231.24	29.64	.52	1.70	.00
	3/ 6/1992	14:25	7.1	3195	234	7.4	236.0	9.1	255	7.9	6.62	2.10	1236.09	.00	.11	.19	.31
	6/19/1992	14:00	3.5	1589	310	7.7	257.0	22.7	280	8.0	1.60	.38	625.98	.00	.10	.00	.00
	8/20/1992	14:10	2.3	1030	305	7.5	-46.8	15.8	313	7.9	.88	.30	425.63	.00	.04	.05	.15
BLACKTAIL CREEK ABOVE CONFLUENCE WITH GROVE CREEK																	
GC-5	5/15/1991	17:00	20.2	9090	280	7.6	288.1	15.5	233	7.5	52.26	3.05	3331.67	36.04	.60	2.07	.44
	3/ 6/1992	15:00	9.3	4185	248	7.7	262.2	10.5	278	7.9	7.62	1.90	1674.24	.00	.15	.25	.45
	6/19/1992	14:50	7.8	3510	425	7.7	246.0	25.3	340	7.8	2.44	1.01	1803.60	.00	.21	.00	.29
	8/20/1992	17:00	6.3	2841	327	7.1	-31.3	18.5	354	7.7	1.87	.78	1395.18	.00	.11	.30	.87
GROVE CREEK (ABOVE BSB LANDFILL)																	
GC-1	5/15/1991	11:10	.7	315	295	8.1	96.5	9.5	340	7.8	.55	.23	234.30	.00	.02	.08	.66
	3/ 6/1992	10:41	.4	180	276	8.2	27.4	3.3	297	7.6	.54	.37	127.64	.00	.02	.02	.04
	6/19/1992	11:12	.2	68	360	7.6	249.3	17.0	420	7.9	.06	.07	54.90	.00	.01	.01	.00
	8/20/1992	12:40	.0	2	372	7.7	-66.5	19.0	424	8.2	.00	.00	1.17	.00	.00	.00	.00
GROVE CREEK (BELOW BSB LANDFILL, @ MT ST)																	
GC-2	5/15/1991	12:30	1.1	495	440	7.6	138.8	11.7	430	7.4	3.56	4.92	428.67	1.53	.04	.11	.31
	3/ 6/1992		.4	180	385	8.1	N/A	6.5	408	7.6	1.15	1.63	156.53	.00	.02	.01	.06
	6/19/1992	11:23	.3	135	469	7.3	229.1	16.9	510	7.5	.29	2.49	114.65	.00	.02	.00	.03
	8/20/1992	13:00	.0	22	540	7.2	-26.9	12.1	580	7.6	.68	1.05	17.82	.00	.00	.00	.01
GROVE CREEK ABOVE CONFLUENCE WITH BLACKTAIL CREEK																	
GC-3	5/15/1991	13:50	.2	90	460	7.7	243.8	17.4	470	7.9	.36	.34	87.10	.27	.01	.05	.04
	3/ 6/1992	13:05	.1	45	476	7.8	129.8	6.5	490	7.5	.27	1.00	46.52	.00	.01	.01	.06
	6/19/1992	16:00	N/A	N/A	770	7.1	113.0	25.3	880	7.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	8/20/1992	13:30	.0	3	490	7.0	-18.8	15.0	510	7.0	.01	.08	3.86	.00	.00	.00	.03
BLACKTAIL CREEK ABOVE CONFLUENCE WITH SBC (USGS GAGE)																	
GC-4	5/15/1991	15:06	19.1	8595	240	7.9	305.8	13.0	248	7.6	47.97	5.56	3335.55	13.07	.66	.93	.00
SS-04	3/ 6/1992	15:30	11.0	4950	305	7.8	244.7	9.1	327	7.8	8.77	56.92	2709.55	.00	.36	.24	.89
	6/19/1992	13:40	19.4	8730	412	7.7	244.0	23.5	359	8.1	13.07	8.26	4705.47	.00	.89	.00	.00
	8/21/1992	09:30	13.0	5850	346	7.4	-36.5	12.4	386	7.5	5.26	6.52	3552.55	.00	.37	.37	2.81
	6/12/1992	07:00	10.0	4500	360	7.4	N/A	18.9	412	7.4	9.81	10.03	3018.40	.00	.93	1.78	4.96
SILVER BOW CREEK AT TEXAS AVE. (METRO STORM DRAIN)																	
SS-02	6/11/1992	16:30	.0	0	180	6.8	N/A	19.1	212	6.7	.00	.00	.00	.00	.00	.00	.00
SILVER BOW CREEK BELOW CONFLUENCE WITH BLACKTAIL CR. (@ MT ST)																	
TM-01	6/12/1992	07:30	N/A	N/A	440	7.1	N/A	19.5	724	7.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	6/19/1992	09:43	10.4	4680	387	7.6	239.7	13.3	404	7.8	3.64	20.01	3682.88	.00	.42	.00	17.83
	8/20/1992	11:50	15.4	6930	377	6.7	-14.2	13.4	394	7.4	7.06	41.09	6665.38	5.81	.36	25.81	104.67
MISSOULA GULCH (@ CENTENNIAL AVE.)																	
TM-02	6/11/1992	17:45	N/A	N/A	510	7.4	N/A	18.0	561	7.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	6/20/1992	11:00	.6	251	424	6.1	13.1	14.1	458	7.1	.02	12.78	508.09	.13	.00	1.58	25.61
SILVER BOW CREEK BELOW COLORADO TAILINGS (@ USGS GAGE)																	
SS-07	6/12/1992	08:00	19.0	8550	480	7.2	N/A	17.9	548	7.2	31.75	161.81	12238.00	.00	2.36	32.98	214.04
	6/19/1992	12:55	20.0	9000	605	7.1	309.7	19.5	530	7.4	17.36	134.75	11060.28	.00	1.37	20.70	174.64
	8/21/1992	09:45	17.0	7650	400	7.1	-21.5	15.9	540	7.4	12.00	87.69	8732.34	.00	1.04	8.61	86.32

N/A - NOT ANALYZED

CLOSED
BUTTE-SILVER BOW LANDFILL
LICENSE NUMBER 20

PIONEER TECHNICAL SERVICES

SPLIT METALS SAMPLES, FEBRUARY 1995

MARCH 1995

IS LOCATED IN THE GROUNDWATER
MONITORING REPORTS ARCHIVE,
BOX NUMBER 7

RECEIVED 3/29/1995

CLOSED
BUTTE-SILVER BOW LANDFILL
LICENSE NUMBER 20

PIONEER TECHNICAL SERVICES

GROUNDWATER SAMPLING, FEBRUARY 1995

MARCH 1995

IS LOCATED IN THE GROUNDWATER MONITORING REPORTS ARCHIVE, BOX NUMBER 7

RECEIVED 3/21/1995

CLOSED
BUTTE-SILVER BOW LANDFILL
LICENSE NUMBER 20

PIONEER TECHNICAL SERVICES

GROUNDWATER SAMPLING, JANUARY 1995

FEBRUARY 1995

IS LOCATED IN THE GROUNDWATER
MONITORING REPORTS ARCHIVE,
BOX NUMBER 7

RECEIVED 2/27/1995